Site classification of the eastern forest region of Daxing'an Mountains

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Abstract Based on the plot data from the investigation and the theory of forest ecology and ecological system, the site classification of the eastern forest region of Daxing'an Mountains was made by mean of mathematical method. The main factors were slope, thickness of soil layer, slope position and slope aspect. Grades of slope were used as the division standard for site type group. The slope aspect, slope position and thickness of soil layer were used as the division standards for site type. Altogether 7 site type groups and 15 main site types were determined the region. It provided reliable fundamental basis for the reasonable management and planting design in the area.

Key words: Daxing'an Mountains, Forest site classification, Site type group, Site type

Study site

The study site is located in the eastern slope of Daxing'an Mountains (47°25'~49°37' N, 119°37'~122°45' E), which belongs to the Balin Forestry Bureau of Nei Menggol. The main topography is lower mountains and hills. The altitude is 400~1 000 m. The annual accumulative temperature (>=10℃) is about 1 845℃. Annual precipitation is 420 mm. Annual average temperature is -15℃. The frost-free period is 97 d. In this area, the zonal soil is brown coniferous forest soil, the other type of soil is meadow soil and bog soil. The main fundamental rock is grinite. The basalt is secondary. The forest vegetation takes Dawur flora as main body and mixed with few typical species of Changba flora. *Larix gmelini* Rupr is the main tree species for the forest vegetation accompanied with *Betula platyphylla* Suk, *Populus davidiana* Dode, *Quercus mongolica* Fisch. The shrubs and herbs under trees are *Rhododendron dauricum, Spilaca salicifolia*, *Corylus mandshurica* Maxim, *Rosa davurica* Pall, *Sanguisorba officinalisl, Paconia lactifoli* Pall, *Deyeuxia langsdonffii* Kuntch, *Dangustifolia* chang, *Carex* spp., *Pyrola incarnata* Fisch, *Vicia sepium*, *Lartemisia annual, Convallaria majalisi, Adenophora tetraphlla* Fisch.

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Study methods

According to selected typical zone in investigation area and the original data of forest management, the topography, terrain and soil were classified in this area. Sample plots for various site types were set up in this area and repeated three times according to the theory of propose sample and even distribution. The order of classification was site type district-->site type group-->site type-->vegetation type.

Results and analysis

Relationship between topography, terrain and soil

Brown coniferous forestry soil is wildly distributed in Daxing'an Mountain region. The investigation data showed that the distribution of all kinds of soil and subspecies soil had close relationship with topography and terrain. The subspecies of typical brown coniferous forestry soil was mainly distributed in the middle site and upper site of the mountain. And the subspecies of non-typical brown coniferous forestry soil was distributed in the middle site and down site of different slope aspect, of which slope degree was lower than 15°. The subspecies of surface brown coniferous forestry soil was distributed in flat slope, of which slope degree was lower than 5°. Original brown coniferous forestry soil was distributed on top of adret and steep-slope of the hill with bare rock. Meadow

soil was distributed in well drainage valley and down slope. Bog soil was distributed in seasonal and yearly round waterlogging valley.

Mathematical analysis of terrain and soil factors

102 plots were carefully investigated in low-lying and hill land of eastern forest region of Daxing'an Mountains. 17 factors of soil and terrain were investigated. They were altitude, slope aspect, slope degree, slope position, depth of soil, depth of layer A, whole porosity, field water capacity, pH, volume weight, whole N, rapid available P, rapid available K, changeable Mg, organic matter. These factors were analyzed using the method of the principal component analysis (PCA). The first principal component was changeable Ca, depth of layer A, pH and slope degree. The second principal component was altitude, content of pebble and volume weight. The third principal component was field water capacity. The fourth principal component was whole porosity. The fifth principal component was slope position and slope aspect. The contribution of former five principal components was 88%.

In eastern forest region of Daxing'an Mountains, the main timber species is *Larix gmelini*. From interrelate coefficient (r) of various principle components on the quantity site factors scoring for *Larix gmelini*, slope degree coefficient (r_1 =0.4476) was the biggest, the second was coefficient of soil depth (r_2=0.4455), and the third was coefficient of slope position (r_3 =0.3575).

r_1 (slope degree)=0.4476
r_2 (soil depth) =0.4455
r_3 (slope position) =0.3575
r_4 (depth of layer A)=0.1160
r_5 (slope aspect)=0.2078
r_6 (pebble content)=0.1524
r_7 (altitude) =0.2212

Site classification system

According to the results of PCA of topography and soil factors, based on principal factor of the bigger interrelate coefficient in the site scoring form for *Larix gmelini* plantation, the slope as an main principal factor and the indicator plant which can reflect the habitat condition of site type were chosen as the main factors for classification of the site type groups, named as slope + indicator plant. For example flat slope--grass forest. The classification of site type was based on the main factors of slope aspect, slope and depth of soil, named as slope aspect + slope + depth of soil + soil type (subtype), such as adret--steep slope—thin--brown coniferous forest. The classifications of vegetation type are mainly depended on forest type on forestland and the grass and shrub on non-forest land. Sometimes there are several vegetable types in one site type, such as grass--larch forest, grass--Scots pine forest, grass--poplar forest and grass--birch forest. Forest type is useful for species selection because it reflects suitable ecological condition for certain species and provides the reliable basis for forest planting design. According to the above analysis and study, site classification system on eastern forestry region of Daxing'an Mountains is presented in Table 1 (next page).

Conclusions

The analyzing results of 17 factors showed that it was reliable to use slope grade to classify site type groups and use slope position, slope aspect and thickness of soil to classify site types for the eastern forest region of Daxing'an Mountains. This method reflected the ecological characteristic of all kinds of site types very clearly.

In eastern forest region of Daxing'an Mountains, 7 site type groups and 15 site types were classified out. Almost all the main topography, terrain and soil types were included. Selected classification factors were clear and easy to measure. It provided a method of practicable, reliable and easy to carry out for the site classification on Daxing'an Mountains.

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Table 1. Site types of eastern forest region of Daxing'an Mountains

Group of site type	Site type	Vegetation type	Topography	Soil	Vegetation	Management method	Suitable species
Rhododendron dauricum-forest on hill top	Thin layer brown forest soil in hill top	RD-LG forest QM-RD-forest RD-BP forest RD-PD forest RD-PS forest	Broad ridge round top of the hill, upper part of steep slope	Thin layer typical brown forest soil	*Rhododendro* *Carex*	Ecological benefit forest Close hill site to facilitate afforestation	
	Middle layer brown forest soil in the middle hill	RD-LG forest RD-BP forest RD and broad leaf mixed forest	Mostly distributed over hill upper part of the steep–back slope	Middle layer typical brown forest soil	*Rhododendro* *Carex*	Ecological benefit forest Close hill site to facilitate afforestation	
Meadow-bushes on steep slope	Beginning of brown forest soil on the steep slope	*Licen bryophte* and *Larix* grassy marshland	Upper adret steep Exposed rocks	Original brown forest soil	*Mnium* *Carex*	Close hill site and protect	
Lespedeza bicolor on the steep slope	Thin layer brown forest Soil on the adret steep	QM -forest BD-forest	Middle and upper part of the slope	Thin layer brown forest soil	*Rhdodendron dauricum* *Carex*	Ecological benefit forest Close hill site to facilitate afforestation	
	Thin layer of brown forest soil on steep-back slope	QM-forest BP-forest	Middle and upper part of adert	Thin layer brown forest soil	*Lespedeza bicolor* *Carex*	Ecological benefit forest Close hill site to facilitate afforestation	
Grass forest on the flat slope	Thick layer raw grass brown forest soil on the gently back slope	Grass-LG forest Grass-PS-forest Grass-PD-forest Grass-BP-forest	Middle and lower part of gently slope	Thick layer raw grassy brown forest soil	*Carex*	Industry forest High yield forest	*Larix*
	Middle layer raw grassy brown forest soil on the sharp adret,	The same as the above, Another is *Corylus—Betula dahurica* forest	Upper part of gently slope	Middle layer raw grassy brown forest soil	*Corylus heterophylla* *Carex*	Industry Forest	*Larix*
	Thick layer raw grassy brown forest soil on the gently back slope	Grass-*Larix* forest Grass-*Betula* forest Grass-*Populus* forest	Middle and lower part of gently slope	Thick layer raw grassy brown soil	*Corylus heterophylla* *Carex*	Industry forest High yield forest	*Larix*
	Middle layer raw grassy brown forest soil on the sharp adret	Grass-*Larix* forest Grass-*Betula* forest Grass-*Populus* forest	Upper part of gently slope	Middle larger row grassy brown forest soil	*Corylus heterophylla* *Carex*	Industry forest	*Larix*
Water-moss forest in valley	Mud-charoal and bog soil in the valley	*Sphagnum-Larix* forest mud-charaoal and bushes forest	Smooth valley land seasonal waterlogging	Mud-charcoal and bog soil	*Betula sphagnum* Willow *Sphagum compatum*	Afforestation after draining off water	*Larix*
Grassy marsh land and bushes in valley	Thick layer of raw grassy brown forest soil in valley	*Hazel* bushes	The foot of the mountain, gently valley land	Thick layer raw grassy forest soil	*Corylus heterophlla* *Carex*	Industry forest High yield forest	*Larix*
	Thick layer of grassy land soil in valley	Five-flower grass valley	Smooth valley land, good for draining off	Thick layer grass marsh land soil	*Gorlyus heterophylla, Carex, Spiraea sericea, Sanguisorba officinalis*	Amelioration, planting high yield plantation	*Larix*
	Thick layer mud-charcoal and bog soil	*Carex* meadow	Valley land, yearly round waterlogging	Thick layer grassy mud-charcoal and bog soil	*Carex*	Ditching and draining off water	*Larix*
	Thick layer grassy marshland bog soil in valley	*Deyeuxia* meadow	Valley land, seasonal waterlogging	Thick layer of grassy marshland and bog soil	*Deyeuxia langsdorffii* *Deyeuxia angistifolia*	Ditching and draining off water	*Larix*
Brook meadow and bushes	Alluvial soil of brook side	*Populus* forest	The bank of river	Alluvial soil of river bank	*Cornus alba* *Padus asiatica* *Carex*	Bank and water-resource conservation forest	

Note: RD—*Rhododendron dauricum*; LG—*Larix gmelini*; QM—*Quercus mongolica*; BP—*Betula platyphylla*; PD—*Populus davidiana*; PS—*Pinus sylvestris* var. *mongolica* ; CH—*Corylus heterophlla* BD—*Betula davurica*; LB—*Lespedeza bicolor*; DL—*Deyeuxia langsdorffii*; DA—*Deyeuxia angustifolia;* SS—*Spiraea sericea;* SO—*Sanguisorba officinalis;* CA—*Cornus alba;* PA—*Padus asiatica,* SC—*Sphagum compatum*